

Responsible Office: AO / Chief Information Officer

Subject: NASA Software Policies

1. POLICY

The following policies cover software created and acquired by or for NASA and also cover Government off-the-shelf (GOTS) software and commercial off-the-shelf(COTS) software when included in a NASA system. These policies shall be applied as appropriate, consistent with sound engineering and risk management practices as determined by cost, size, complexity, life span, risk, and consequences of failure. NASA policy regarding software management, engineering, and assurance is to accomplish the following:

- a. Manage, engineer, and assure software in accordance with common industry standards, processes, and best practices; document the use of standards, processes, and best practices in accordance with ISO 9000; and tailor standards, processes, and best practices to the development or acquisition.
- b. Implement and integrate software engineering processes and practices with other system development and program/project processes and practices. Develop a plan for acquisition and life-cycle management of the software as part of the program/project plan. This plan should be developed prior to selection of the provider and should address, at a minimum, design tradeoff management, risk management, requirements management, software project planning, project tracking and oversight, software product engineering, subcontract management, configuration management, quality assurance, and peer review.
- c. Develop and maintain a total estimated software life-cycle cost and where appropriate, perform tradeoff studies which address use of COTS and GOTS software versus created software to satisfy requirements before software is created or acquired.
- d. Demonstrate that the provider of software to be developed has proven organizational capabilities and experience to deliver quality software on time and within budget; require acceptable evidence of the entity's software management, engineering, and assurance standards, processes, and practices to produce quality software. Examples of current acceptable evidence include an independent certification of ISO 9001 compliance as described in ISO 9000-3 or an independent assessment of a software Capability Maturity Model (CMM) rating of 3 or above. The provider shall develop a plan to manage software throughout the program/project life cycle before the software requirements specification is complete and software design and coding takes place. The plan shall address items required in 1.b.
- e. Document software as to its form and function and verify that such software performs the functions claimed on the platform(s) for which it is designed without harm to the systems or the data contained therein.
- f. Develop risk analyses and management strategies; identify, analyze, plan, track, control, and communicate risks at each stage of the life cycle; document or reference (i.e., their location specified) the results of risk analyses and management strategies in program/project plans; and employ verification and validation

techniques for risk mitigation, including Independent Verification and Validation (IV&V), as appropriate, based on cost, size, complexity, life span, risk, and consequences of failure.

- g. Facilitate reuse of NASA-funded software, as well as transfer, consistent with law and applicable agreements, for commercial, industrial, educational, and governmental purposes; and protect NASA-funded or -created software as valuable intellectual property during all phases of the life cycle.

2. APPLICABILITY

This Directive applies to NASA Headquarters and Centers, including Component Facilities, and the Jet Propulsion Laboratory to the extent defined in its contract, for all software acquisitions and developments initiated by NASA after the effective date of this directive. This Directive applies to software acquisitions and developments initiated by NASA prior to the effective date when determined by either the responsible Program Associate Administrator or the Center Director of the implementing Center.

3. AUTHORITY

- a. 42 U.S.C. 2473(c)(1) and 2457, section 203 (c)(1) and section 305 of the National Aeronautics and Space Act of 1958, as amended.
- b. 44 U.S.C. 3501, et seq., Paperwork Reduction Act of 1995, as amended.
- c. 40 U.S.C. 1401, et seq. (Information Technology Management Reform Act, Division E of Public Law 104-208, renamed the Clinger-Cohen Act of 1996 by Section 808 of Public Law 104-208).
- d. OMB Circular No. A-130, Management of Federal Information Resources.

4. REFERENCES

- a. See Attachment 1 for references that apply to the management, engineering, and assurance of NASA software.
- b. See Attachment 2 for references that are relevant to the management, engineering, and assurance of NASA software.

5. RESPONSIBILITY

The NASA Chief Information officer (CIO), the NASA Chief Engineer, and the Associate Administrator for Safety and Mission Assurance (AA-SMA) are responsible for jointly promoting software policies, standards, best practices, and guidance in their areas of responsibility. They shall coordinate efforts to maximize the commonality, clarity, and effectiveness of direction and guidance. Roles and responsibilities for all NASA entities relative to this policy will be carried out within the framework of the Strategic Management Handbook and are not repeated here.

- a. The NASA CIO shall promote the cost-effective acquisition, development, and operation of software in support of NASA missions, programs, and institutions. This shall be accomplished in conjunction with the Office of Safety and Mission Assurance, the Office of the Chief Engineer, and the Enterprise offices.

- b. The NASA Chief Engineer shall integrate NASA software management, engineering, and assurance policies, standards, best practices, and guidance into directives applicable to NASA's systems engineering and program management processes. The NASA Chief Engineer and the Engineering Management Council (EMC) shall charter a Software Group (SG) to advise the Agency on software-related matters and recommend software management, engineering, and assurance policies, standards, best practices, and guidance.
- c. The AA-SMA shall assure the safety, quality, and reliability of NASA software; review project software processes and make recommendations to the governing Program Management Council (PMC); conduct oversight of NASA's software assurance programs; and conduct Process Verification Reviews of programs/projects to ensure compliance with this Directive and independently assess project software management, engineering, and assurance practices. The AA-SMA shall appoint and support representatives to the SG.
- d. The Associate Administrator for Aeronautics and Space Transportation Technology shall, through its Institutional Program Office role, sponsor the NASA Software IV&V Facility in West Virginia under the management and oversight of the Ames Research Center. This facility shall support NASA's program for improving software assurance, including conducting IV&V and other trusted verifications; carry out the collection and analysis of the metrics collected, pursuant to paragraph 7 of this Directive; submit an annual report on the implementation of Agency software policies and practices to the NASA EMC; and coordinate its activities through the NASA CIO, NASA Chief Engineer, and AA- SMA, as appropriate.
- e. Enterprise Associate Administrators and Center Directors shall appoint and support representatives to the SG.
- f. The governing PMC shall review program and project software processes and products including, but not limited to evidence of conformance to this policy; use of IV&V and other trusted verifications (e.g., independent assessments and peer reviews); and other risk mitigation processes as appropriate based on program/project cost, size, complexity, life span, risk, and consequences of failure. The PMC shall record the results of its reviews and forward copies to the NASA IV&V Facility.

6. DELEGATION OF AUTHORITY

None.

7. MEASUREMENTS

- a. The following shall be evaluated for compliance with this Directive:
 - (1) Evidence of project conformance to this policy as reported to the governing PMC.
 - (2) Agency trends on the following:
 - (a) Software cost and schedule baseline deviations; and
 - (b) Degree to which delivered software satisfies its requirements, including safety, quality, and reliability measures.
 - (3) Results of the following:

- (a) Assessments and audits of conformance to ISO 9001 and the CMM in NASA software creation and acquisition organizations;
- (b) Other surveys relating to the implementation of this Directive;
- (c) Improvements in software acquisition and creation on software projects, resulting from the use of the CMM;
- (d) Improvements in management of software creation and acquisition, resulting from case studies and shared experiences.

b. Specific responsibilities for collecting, analyzing, and reporting metrics are contained in NPG 2820.

8. CANCELLATION

NMI 2410.10B, dated April 20, 1993.

Daniel S. Goldin

Administrator

ATTACHMENT A: (TEXT)

ATTACHMENT 1 APPLICABLE REFERENCES

These references apply to the management, engineering, and assurance of NASA software.

- (1) NPD 2091.x, Inventions Made by Government Employees.
- (2) NPD 2210.x, External Release of NASA Software.
- (3) NPD 2800, Managing Information Technology.
- (4) NPD 2810.x, Security of Information Technology.
- (5) NPD 7120.4, Program/Project Management.
- (6) NPD 8700, NASA Policy for Safety and Mission Success.
- (7) NPG 2210.x, External Release NASA Software.
- (8) NPG 2800.x, Guidance for Managing Information Technology.

- (9) NPG 2810.x, NASA Information Technology Security.
- (10) NPG 2820.x, NASA Software Management, Engineering, and Assurance Guidelines.
- (11) NHB 5300.4(IG), NASA Assurance Terms and Definitions.
- (12) NPG 7120.5, Program and Project Management Processes and Requirements.
- (13) NASA-STD-1740.13, NASA Software Safety Standard.
- (14) NASA-STD-2201, NASA Software Assurance Standard.
- (15) ISO 9000-3, Quality Management and Quality Assurance - Part 3 Guidelines for the Application of ISO 9001: 1994 to the Design, Development, Supply, Installation, and Maintenance of Computer Software.
- (16) Carnegie Mellon University/Software Engineering Institute, Continuous Risk Management Guidebook, 1996.
- (17) OMB Circular No. A-119, Federal Participation in the Development and Use of Voluntary Standards.

ATTACHMENT 2

RELEVANT REFERENCES

These are relevant to the management, engineering, and assurance of NASA software.

- (1) CMU/SEI - 93 - TR - 24, The Capability Maturity Model for Software, Version 1.1, February 1993.
- (2) CMU/SEI - 93 - TR - 25, Key Practices of the Capability Maturity Model, Version 1.1, February 1993.
- (3) CMU/SEI - 96 - TR - 20, The Software Acquisition Capability Maturity Model (SA-CMM), Version 1.01, December 1996.
- (4) EIA/IEEE J-STD-016-1995, Software Life-Cycle Processes, Software Development Acquirer-Supplier Agreement.
- (5) ISO 9001, ANSI/ASQC Q9001 - 1994, Quality Systems - Model for Quality Systems - Model for Quality Assurance in Design, Development, Production, Installation, and Servicing.
- (6) ISO/IEC 12207: 1995, Information Technology - Software Life-Cycle Processes (IEEE/EIA 12207US - TBD).
- (7) MIL-STD 498, Software Development and Documentation (IEEE 1498/EIA640).
- (8) NASA-STD-2100-91, NASA Software Documentation Standards.
- (9) NASA-GB-A201-89, NASA Software Assurance Guidebook.

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